Before the

Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Headsight Inc.	)	
Waiver of Part 15 of the Commission's Rules	)	ET Docket No. 16-44
Applicable to Ultra-Wideband Devices	)	

Reply Comments of Headsight Inc.

Headsight Inc. ("Headsight"), through its counsel, hereby submits these Reply Comments to address the limited issues raised regarding its waiver request in the above-captioned proceeding ("Waiver Request"). Headsight requested a waiver of the Commission's ultra-wideband ("UWB") rules to permit the marketing and operation of its unique UWB imaging device, known as the Terrahawk, for farming operations. The one and only commenter raising any concerns about the Waiver Request is Trimble Navigation Limited ("Trimble") which is a manufacturer of Global Positioning System ("GPS") devices.

Trimble recognizes Headsight's efforts in advancing precision agriculture ("PA") through the Terrahawk technology, but is concerned that the Waiver Request does not provide sufficient information to determine whether existing GPS applications, including those used in agriculture, might be "compromised" by use of the Terrahawk.[1] Trimble asks the Commission to develop a

[1] Trimble Comments at 1.

more detailed record of the issues before considering the Headsight request.[2] The purpose of these Reply Comments is to reiterate and clarify certain aspect of the Terrahawk device and its operations, and to address some of the statements of Trimble. As discussed below, Headsight believes that sufficient information has been provided to the Commission about the Terrahawk, and that there is no reason to delay granting the Waiver Request.

In its Waiver Request, Headsight is merely asking the Commission to relax its UWB operational rules to (i) permit the operation of the Terrahawk in rural agricultural settings that pose less of an interference threat to GPS than the myriad of uses currently allowed under the rules, and (ii) permit the use of the Terrahawk above the 1 meter threshold in certain situations (depending upon how the term "ground" is defined) that pose no additional interference risk to GPS operations given that transmissions remain directed towards the ground. Underlying Trimble's Comments are unfounded concerns that the Terrahawk will interfere with GPS operations. These concerns are essentially the same issues raised repeatedly by the GPS industry during the twelve (12) years of UWB rulemaking. The potential for UWB interference to GPS operations has been analyzed extensively by the Commission and addressed comprehensively in the Part 15 Subpart F technical standards; technical standards which the Terrahawk will fully comply. Indeed, GPR and GPS must co-exist (and avoid cross-interference) to maximize the benefits of both technologies and for PA to succeed.

[2] *Id.* at 2.

Trimble raises a number of specific interference-related concerns in its Comments. Below are Headsight's responses to these issues.

Permitting UWB GPR for Agricultural Purposes

Trimble asserts that the UWB rules were carefully crafted to prevent interference to GPS operations and questions whether these rules should be changed to introduce an additional source of potential interference.[3] Trimble contends that Headsight has not provided a technical justification for expanding the "class of applications" for which UWB is permitted nor does Headsight clarify the scope of PA devices that would be covered by the waiver.[4] Trimble also alleges that the waiver request fails to demonstrate compatibility between UWB farm equipment and GPS receivers used for "agriculture applications, on an aircraft landing on a runway adjacent to a farmer's field, or in a fire truck on a highway that runs alongside the farmer's field."[5]

To be clear, the Waiver Request does not propose any relaxation in the UWB emission limits or technical standards that apply to UWB GPR devices and which currently protect GPS operations from harmful interference. The Terrahawk will fully comply with these emission limits and technical standards. As a result, the use of the Terrahawk in rural agricultural settings will not cause any harmful interference to GPS operations.

[3] Trimble Comments at 2.
[4] *Id.* at 3.
[5] *Id.*

The Waiver Request explains that there was absolutely no discussion by the Commission or industry members about agricultural applications of UWB GPR technology at the time the UWB GPR rules were being developed.[6] Nobody argued against the use of UWB GPR devices for agricultural purposes, and nobody expressed concern that such use would create harmful interference. It was an application that was simply overlooked.

To clear up any potential confusion as to the scope of PA devices covered by the Waiver Request, the Terrahawk will be used solely in rural settings and such use will take place seasonally and for limited periods of time. There will be no "harvesting" in city gardens using farm machinery equipped with Terrahawk devices.[7] Indeed, operation of the device in more remote rural areas poses even less of a threat to GPS than the many urban uses of GPR that exist today (where there is also no evidence of harmful interference caused by such devices).

With respect to compatibility with GPS, GPR devices have operated compatibly with GPS operations since 2002, often co-located on the same end user device. GPR and GPS have operated compatibly in the areas of construction, law enforcement, firefighting, emergency rescue and scientific research in urban and rural environments, year round. To this end, as discussed in Section B(2) of the Waiver Request, Headsight performed compatibility testing between its Terrahawk GPR device and a GPS receiver mounted on the same piece of farming

[6] Waiver Request at 9-10.
[7] Trimble expressed concern that the term "crops" could be interpreted to include urban nurseries or central city gardens. Trimble Comments at 3.

machinery and found no interference of any kind.[8] This compatibility is a necessity for the success and proper operation of the Terrahawk because the farming equipment that will be configured with the Terrahawk also employ GPS receivers.

Trimble is also worried about the impact of the Terrahawk on non-agriculture GPS applications, citing to aircraft landing on runways adjacent to a farmer's field, and a fire truck speeding along a highway that runs alongside a farmer's field. Logically, if on-board interference between co-located devices is not an issue, how could it be an issue for distant aircraft or speeding fire vehicles? Just last week in an unrelated proceeding, the Commission noted that the operation of a Part 15 white space device "located on farm machinery within the defined boundary of an agricultural field … will mitigate the potential for harmful interference."[9] Trimble is ignoring years of actual UWB GPR operations without evidence of harmful interference to GPS equipment, as well as the government and private reports and tests demonstrating the lack of any harmful interference when UWB devices operate in accordance with the UWB emission limits and technical standards.

Finally, as noted in the Waiver Request, GPR devices are currently being marketed for use in agriculture.[10] Headsight believes that its Waiver Request is the first step toward bringing "off-

[8] Waiver Request at 13. Headsight has learned that the test report (referenced as "Attachment 4" in the Waiver Request) which demonstrates this compatibility did not make it into the docket when the Waiver Request was initially submitted. Attached herewith is a copy of this report, dated October 27, 2015.
[9] *Deere & Company Request for Limited Waiver of Part 15 Rules for Fixed White Space Device,* Order, ET Docket No. 15-184 at ¶ 16 (rel. March 24, 2016).
[10] Waiver Request at 3.

label" GPR applications out of the shadows and giving farmers access to a technology that they can use in a lawful manner.

Above Ground Issue

Trimble notes that UWB devices in PA might operate more than one meter above ground and faults Headsight for not providing RF attenuation data on crops as compared to rock, concrete or steel.[11] Trimble also notes "that some crops grow quite tall (*e.g.*, corn and fruit trees)" and warns that this could result in harmful interference to GPS over a wide area even if the GPR device is pointed toward the ground.[12]

As a threshold matter, only certain crops[13] and certain types of farm equipment (including those described in the Waiver Request[14]) require the Terrahawk device to be located above the 1 meter limit during operation. For most crops (including corn) and most types of farm equipment, the Terrahawk would generally float less than one meter above the soil while operating. Moreover, as noted in the Waiver Request, Canadian regulations define the term "ground" to include "any lossy dielectric materials."[15] This language was intended to clarify that ground imaging devices can be used to image snow, crops and other ground-based structures, and that the "ground" begins at the exposed layer of snow, the crop canopy and the exposed ground-based structure.

[11] Trimble Comments at 4.
[12] *Id.*
[13] In response to a comment by Trimble, apple (and other fruit) trees are not a "crop" that would be harvested with farm machinery equipped with the Terrahawk.
[14] Waiver Request at 7-8.
[15] *Id.* at 15.

Therefore, it should not matter if farm machinery equipped with the Terrahawk operates above the crop canopy (but never more than one meter above the crop canopy) as long as what is being imaged requires that emissions be directed toward the ground.

As for Trimble's concerns about attenuation, there is no need to show attenuation comparisons to rock, concrete or steel. This information is irrelevant as to whether the Terrahawk creates harmful interference (which Headsight has already demonstrated would not be the case). Headsight is merely pointing out that operations above 1 meter are not going to be in free space and that the transmission is always going to be directed into the ground, vegetation, debris and other ground structures just like other permissible UWB operations conducted for construction, law enforcement, etc. purposes.

Using Other Spectrum

Trimble questions why the Headsight device must operate in spectrum designated for UWB operations rather than other spectrum (such as 76 – 81 GHz) under consideration by the Commission for radar applications.[16] Trimble's comment ignores the Commission's rationale for adopting UWB rules and almost two decades of work to facilitate the deployment of UWB technologies.

[16] Trimble Comments at 4.

Although the Commission initially adopted a measured approach to the deployment of UWB technology (primarily due to initial concerns about potential harmful interference), the Commission always recognized the potential benefits of this technology. With each passing year, it has become clear that the UWB technical standards provide more than adequate protection to GPS operations. Indeed, the Commission has repeatedly shown a willingness to grant waivers to permit the use of UWB technologies that do not fall squarely within the Commission's rules. The UWB rules were developed for the type of technology that Headsight has developed and, except for two operational limitations, the Terrahawk satisfies these UWB rules. Therefore, it makes little sense for Trimble to suggest that a UWB device should not be able to operate in accordance with the Commission's UWB rules across spectrum that includes GPS frequencies.

Moreover, operating the Terrahawk within the 76 - 81 GHz band is unworkable for various reasons. For example, radar signals at these frequencies will reflect and not effectively penetrate the crops and other ground structures. Without the ability to penetrate ground structures, the signal would not provide the kind of resolution and precision needed to adequately determine the characteristics of the crop/ground being investigated.

Conclusion

The Commission should be mindful of the fact that only one commenter even participated in this proceeding which demonstrates how little concern there is with the introduction of UWB GPR into PA. Headsight is simply asking the Commission to waive two operational limitations in the

UWB rules so that the Terrahawk can be used for agricultural purposes and, in certain limited situations, above the one meter threshold. At the time the UWB GPR rule limitations were adopted, the Commission was not thinking about agricultural use and whether one vs. two meters above ground would be an appropriate threshold for these applications. However, the Commission did care about protecting GPS operators from harmful interference, which was accomplished by adopting stringent UWB GPR emission limits and technical standards. Today, the Terrahawk can promote an important public interest by bringing technical and economic efficiencies to agriculture without risk to other spectrum users. Based on the foregoing and the information contained in the Waiver Request itself, Headsight respectfully requests that the Commission grant the Waiver Request.

Respectfully submitted,

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ATTACHMENT 4

Oct 27, 2015
Paul Rexroth

Terrahawk / GPS Testing

Objective

To determine if the emissions from the Terrahawk would interfere with an OEM John Deere GPS receiver

Equipment

- Terrahawk Sensor, SN 1500159, HW 1.00, Software Version 3.19
- John Deere StarFire ITC receiver using SF2 signal
- CAN extension harness to powered the Terrahawk sensor from the main Horizon harness

Procedure

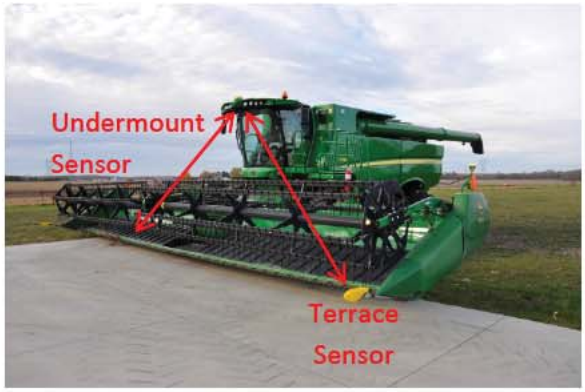
- Started the combine and allowed the; GPS receiver to find satellites
- Pointed the Terrahawk sensor to emit directly toward the GPS receiver with 30 inches between them
- A second person sat in the cab and watched the connections to see if any of them were lost when the radar emissions were introduced

Results

- Moving the physical sensor case between the receiver and a satellite caused it to lose reception regardless of whether or not the Terrahawk was emitting toward the receiver
    - This is expected, any physical object (not transparent to the GPS signal) shielding the view of the receiver form the satellite will cause it to lose reception
- Holding the Terrahawk (where it was not physically blocking the receiver from a satellite) so that it was emitting directly toward it at a distance of 30 inches did not appear to effect its connection to, or reception from, any of the located satellites

Conclusion

This was a representative test of a GPS receiver that will commonly be used on the same piece of agricultural machinery as the Terrahawk sensor. The emissions of the Terrahawk did not appear to affect the GPS receiver and during the test the receiver experienced far more direct emission than what would ever be expected during operation. During normal operation, the Terrahawk sensor should always be mounted significantly below the combine GPS receiver, the emissions of the Terrahawk should always be directed toward the ground, and the Terrahawk sensor should never have displacement of less than 8ft from a GPS receiver. In addition, there will often be parts of the header, combine or mounting brackets obstructing the direct line of "sight" between the Terrahawk sensor and the combines GPS receiver. The results of this test indicate that the Terrahawk should not interfere with the function of the GPS StarFire receiver on a John Deere combine.



CERTIFICATE OF SERVICE

I hereby certify that true and correct copies of the foregoing Reply Comments were served via first-class mail, postage prepaid, or via electronic mail upon the following individuals on this 5h day of April 2016:

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